

CHAPTER 15

SOIL REMOVAL, FREE-PRODUCT REMOVAL, AND BACKFILLING PROCEDURES

15-1. General. This chapter discusses the procedures for excavation of soils and any associated free product when small quantities of hydrocarbon-contaminated soils require treatment or disposal. An example is removal of soils when small releases have occurred and are confined to the tank excavation; these soils can be removed or treated onsite. The amount of soil to be removed is dictated by the volume of released hydrocarbon, the depth and area of liquid hydrocarbon penetration, the ease with which the soil can be removed and properly treated, available funding, and the state or local regulatory requirements.

This guidance is only intended for removing small, reasonable amounts of contaminated soil and free product in the excavation. Refer to Chapter 5 for the definition of contaminated soil. If it appears that extensive contamination is present that cannot be cleaned up by the provisions described in this EM, the reader should proceed with corrective action plan procedures.

15-2. Precautions. Keep the following precautions in mind:

- a. Petroleum-contaminated soil may be flammable or combustible and can be a source of potentially explosive vapor. Care must be taken, both during and following excavation, that vapor or liquid from the soil is not allowed to accumulate in a confined area and pose a fire or explosion hazard.
- b. Digging should be done with extreme care to avoid sparking from stones and igniting the product.
- c. Equipment should operate slowly, with due regard for the danger of explosion. In certain circumstances, moving the earth may ventilate the saturation area sufficiently to relieve the vapor concentration, allowing movement and activity to proceed safely.
- d. If the soil is to be stored onsite after excavation, cover or store in a bermed or otherwise contained area (such as stored on and covered by polyethylene sheets) so that leached petroleum product cannot be released into surrounding soil, surface water, or groundwater.
- e. The contractor should have spill response materials available as required by guide spec 02120 referenced in paragraph 1-4.
- f. Offsite transport and disposal of contaminated soil must be in accordance with state and local regulations. Excavation of

contaminated soil creates increased exposure potential for site personnel, the public, and the environment.

- g. In confined spaces, air-vapor concentrations should be monitored to ensure that hazardous levels are not reached.

15-3. Equipment.

- a. Soil. Transportation of contaminated soil requires conventional earth-moving equipment.

Many types of equipment are available for excavation, loading, and removal of soils. Standard construction equipment is typically employed, but consider factors such as safety, depth of contamination, and soil stability. Backhoes with 0.38 m³ (0.5 CY) capacity have a maximum reach of 8 meters (26 feet) and a maximum excavation depth of 5 meters (16 feet). Larger backhoes with 2.7 m³ (3.5 CY capacity) have the ability to remove soils at depths of up to 14 meters (45 feet) at maximum digging angles of 45 degrees.

The major hauling cost factor is the distance to the disposal facility. Site-specific conditions, community and interstate relations, and regulatory measures affect disposal costs. In some states the contaminated soils are considered a special hazardous waste and must be handled, hauled, and disposed of accordingly.

- b. Free Product. Free product may be removed using positive displacement pumps or vacuum trucks. In some instances, if the amount of free product is small, absorbent booms may be used to collect the product. Additional guidance on the recovery of free product may be found in EPA/510/R-96/001.

15-4. Soil Removal. Excavation guidelines include the following:

- a. Excavate the hole downward and outward in consultation with the governing agency or Environmental Coordinator.
- b. Proceed until all the soils contaminated above regulatory limits have been removed or until a reasonable amount of excavation has occurred. The designer should specify a maximum cubic yardage of contaminated soil excavation from each tank area without prior approval from the contracting officer's representative (COR). If a minimum additional amount of contaminated soil requires removal to result in a clean closure, the contractor will obtain approval from the COR to perform the additional excavation. The bid form can identify a minimum quantity of soil to be removed with a second quantity of soil to cover a worst-case scenario.

- c. Perform appropriate verification testing in accordance with the IA requirements if widespread contamination is present.
- d. Backfill the excavation with clean fill. Clean fill is typically defined as fill that has no evidence of contamination, or has contamination levels below regulatory limits. The IA must be consulted to define the requirements of clean fill.
- e. See Chapter 16 for more details. These excavations will be done safely according to the local codes and regulations governing safe excavations and EM 385-1-1 and 40 CFR 1926.650-1926.653. Table 15-1 provides an estimated quantity of soil that is typically removed from an UST excavation based on tank size.
- f. Contaminated Soil. If the soil in the excavation is contaminated, follow these steps:
 - (1) Prepare an area to store the excavated soil. This can be achieved by placing 6-mil or heavier polyethylene sheeting on the ground and placing excavated soil on top. This prevents contaminants in the excavated soils from migrating into the uncontaminated soils.
 - (2) Cover this stockpile after work each day by a similar sheet of polyethylene to protect the excavated soils from infiltration due to precipitation and to help contain vapors released.
 - (3) Make provisions to divert surface runoff from soil stockpiles, as well as surface runoff, to reduce the amount of contaminated water.
 - (4) An alternative method, and in some areas a requirement, is to place the excavated soils directly into 55-gallon drums. Coordinate with the local implementing agency regarding approved stockpiling procedures.
- g. Sampling. After tank removal has been completed, the soil in the bottom of the excavation should be sampled according to federal and state requirements.
 - (1) Take these samples, at a minimum, from the bottom of the excavation from the end locations of the tanks (see Chapter 6).

TABLE 15-1 Estimated Quantity of Soil to be Removed by Tank Size (Average)					
Tank Size liters (gallons)	Tank Diameters meters (feet)	Tank Length meters (feet)	Excavation Size cubic meters (Bank CY)	Volume of Tank CM (CY)	Estimated Soil Excavated CM (Bank CY)
1,890 (500)	1.22 (4.00)	1.83 (6.00)	31 (40)	2.13 (2.79)	28.5 (40)
3,780 (1,000)	1.22 (4.00)	3.50 (11.50)	46 (60)	11.41 (5.35)	40.5 (55)
7,570 (2,000)	1.93 (6.33)	2.80 (9.17)	61 (80)	8.18 (10.70)	52.0 (70)
11,350 (3,000)	1.93 (6.33)	4.17 (13.67)	76 (100)	12.18 (15.93)	65.5 (85)
15,140 (4,000)	1.93 (6.33)	5.18 (17.00)	92 (120)	15.15 (19.81)	76.0 (100)
18,925 (5,000)	2.44 (8.00)	4.32 (14.17)	103 (135)	20.16 (26.37)	84.0 (110)
22,700 (6,000)	2.44 (8.00)	5.05 (16.58)	115 (150)	23.60 (30.87)	93.0 (120)
30,280 (8,000)	2.44 (8.00)	6.73 (22.08)	145 (190)	31.43 (41.11)	113.0 (150)
37,850 (10,000)	2.90 (9.50)	6.02 (19.75)	165 (215)	39.64 (51.85)	124.0 (160)
45,420 (12,000)	2.90 (9.50)	6.91 (22.67)	183 (240)	45.50 (59.51)	137.0 (180)
56,780 (15,000)	2.90 (9.50)	9.07 (29.75)	230 (300)	59.71 (78.10)	168.0 (220)
75,700 (20,000)	2.90 (9.50)	11.51 (37.75)	279 (365)	75.77 (99.10)	202.5 (265)

Assumptions:

1. Amount of fill over tank is 1 meter (3 feet).
2. Soil around perimeter of tank to be excavated is 1 meter (3 feet) (the width of a backhoe bucket).
3. Stained soil under tank extends down 0.7 meters (2 feet).
4. Tank volume calculation does not account for domed ends.
5. Formula for excavation size:

$$((\text{tank diameter} + 5\text{ft}) * (\text{tank length} + 6\text{ ft}) * (\text{tank diameter} + 6\text{ ft})) / 27 \text{ CF/CY (Conversion from CY to CM is 0.76455).}$$
6. Formula for tank volume:

$$(\text{Tank length} * \pi * \text{tank diameter}^2 / 4) / 27 \text{ CF/CY (Conversion from CY to CM is 0.76455).}$$

- (2) Take samples with a backhoe and containerize in small vessels, such as a plastic bag or jar for field testing as detailed in Chapter 6. These tests will characterize the extent of contamination and subsequent excavation and help in the segregation of clean and uncontaminated soils. It must be noted that these field tests are not a substitute for the laboratory analytic tests that must be done. Field tests are used to differentiate between clean soils and those that are suspected to be contaminated.
 - (3) Submit samples for analytic tests. Laboratory confirmation based on samples collected from excavation bottoms and soil stockpiles is necessary in most states to confirm clean closure. Check with the IA for specific requirements.
- h. Landfilling Requirements. A common remedial action for excavated soils has been disposal in landfills. Varying interpretations exist regarding classification of hydrocarbon-contaminated soils as hazardous or nonhazardous. Levels of contaminants allowable for landfilling under applicable regulations must be determined in developing a sound disposal strategy.
- i. Onsite Treatment. Various treatment and disposal options for excavated soil containing petroleum hydrocarbons are available but decisions must be based on and in accordance with state and local regulations. Treatment of soils may require an air permit for volatile organic compounds from the state agency that has jurisdiction. The methods of onsite treatment and soil replacement discussed below can be viable if approved by the regulatory agencies. Refer to EPA/530/UST-88/001 for additional information.
 - (1) Land treatment (landfarming). Land treatment is a process by which contaminated soils are removed and spread over an area to enhance naturally occurring processes such as biodegradation and volatilization. A centralized location, such as a landfill, airfield, or other isolated location should be used for land treatment.
 - (2) Aeration/enhanced volatilization. Soil aeration by mixing and exposure to air can reduce hydrocarbon concentrations to acceptable levels. This process may be as simple as overturning the soils with excavation equipment, tillers, or shakers to increase volatilization or enhancing vapor removal by forced or passive venting with an engineered venting system.

- (3) Thermal treatment. Incineration and high temperature stripping of residual hydrocarbons are methods employed in some circumstances for the onsite treatment of soils. Treatment costs and local air quality regulations are major factors controlling the use of these techniques. Examples of thermal treatment technologies include low-temperature thermal desorption or asphalt kilns. When an asphalt kiln is used, the unit should be proven clean prior to processing any soil.
 - (4) Isolation/containment. Isolation/containment is a process in which the impacted soils are isolated through the use of caps, slurry walls, grout curtains, or cutoff walls.
 - (5) Soil slurry bioreactor. The soil-slurry-bioreactor process entails mixing a variety of agents into the soil to encourage microbial activity.
- j. Asphalt Incorporation. Asphalt incorporation is a process whereby soils containing residual hydrocarbons are incorporated into hot asphalt mixes as a partial substitute for aggregates. During the heating of the mixture, the more volatile components are vaporized, and the remaining compounds are incorporated into the asphalt mixture. This alternative is normally a viable disposal option only when an asphaltic paving project is ongoing within the project area. An active project is normally necessary to lead to a demand for the contaminated soil material as an asphalt admixture.
- k. Excavation Liner. In some instances, a 6-mil liner is placed in the excavation and then the contaminated soil is placed back in the excavation. Check with the IA prior to using this method.

15-5. Free-Product Removal. Free product should be removed, not for remediation purposes, but to prevent further damage to the environment. If possible, the excavation should be sloped to allow pooling of the free product. A pump or vacuum truck can then be used to remove the free product from the excavation. Refer to Chapter 12 for operation of product removal equipment and waste disposal.

15-6. Backfill, Compaction, and Testing.

- a. Backfilling.
 - (1) Coordinate with the customer concerning the option of leaving excavations open pending the return of laboratory test results. Laboratory turn-around time plays a critical role in the duration that an excavation must be left open. If field analysis is allowed by the regulatory authority, this will reduce or eliminate turn-around time concerns.

- (2) Secure open excavations and stockpile areas while awaiting confirmation test results.
 - (3) Backfill excavations immediately after confirmation test results have been approved. If contaminated material removal is part of a larger project, suitable backfill material, as well as topsoil and grading requirements are specified in CEGS 02221-*Excavating, Filling, and Backfilling for Buildings* or CEGS 02222-*Excavating, Filling and Backfilling for Utility Systems*. In situations that involve only tank removal, grading, backfill, and compaction should be addressed in CEGS 02115-*Removal of Underground Storage Tanks*. Special information concerning allowable contaminant levels should be included in those specifications if used.
- b. Backfill Material. In many cases, the degree of engineering control of the materials used as backfill may not need to be as stringent as described below. In other cases, such as under pavements, special compaction and material requirements may apply, and the specifications will need to be revised to address these special requirements or another specification section should be referenced.
- (1) Obtain backfill material from a location defined by the user or if using an off-site source, verify through analytical testing to ensure contamination is not present above regulatory levels for suitable backfill.
 - (2) Test off-site backfill for contamination in accordance with CEGS 01450-Chemical Data Quality Control. Backfill should be classified in accordance with ASTM D 2487 as GW, GP, GM, GC, SW, SP, SM, SC, MH, CL, or CH and should be free from roots and other organic matter, trash, debris, snow, ice or frozen materials. If off-site backfill is used, soil classification test results should be approved prior to bringing the material on-site.
 - (3) Test backfill material for Atterberg limits ASTM D 4318, grain-size distribution, and compaction characteristics ASTM D 698, ASTM D 1557 at a frequency of once per 3,000 cubic meters (3,000 cubic yards) or a minimum of one test per borrow source. *Off-site backfill should not be used until chemical and physical test results have been submitted and approved.*
- c. Compaction.
- (1) Place approved backfill in developed areas in lifts with a maximum loose thickness of 200 mm (8 inches), compacted to 90 percent maximum dry density for cohesive soils, or 95 percent

maximum dry density for cohesionless soils in accordance with ASTM D 698 or D 1557.

- (2) Perform density tests at a frequency of once per 930 square meters (10,000 square feet) per lift. A minimum of one density test should be performed on each lift of backfill placed. In open areas without special compaction requirements, a maximum density of 85 percent using 300-mm (12-inch) lifts will be acceptable. A method specification is also frequently used in which a prescribed number of passes using a specified piece of equipment is required.

- d. Density Testing. Determine field in-place dry density in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. If ASTM D 2922 is used, a minimum of one in ten tests must be checked using ASTM D 1556 or ASTM D 2167.

15-7. Special Waste Requirements. Though petroleum-contaminated soils that do not exhibit a RCRA hazardous waste characteristic are not subject to hazardous waste regulation, many states may still regulate them as "special wastes." Typically, these soils are either placed in special waste management units or are treated to below certain concentration levels before final disposal. Implementing agencies may also be able to assist in identifying any special handling requirements. Consult individual state regulations. A list of contacts is provided in Appendix B.